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(71) Applicant: KABUSHIKI KAISHA TOSHIBA
72, Horikawa-cho Saiwai-ku
Kawasaki-shi Kanagawa-ken Tokyo(JP)

(72) Inventor: Yamaki, Kazunori
C/o Patent Division Toshiba Corporation
1-1 Shibaura Minato-ku Tokyo(JP)

(74) Representative: BATCHELLOR, KIRK & EYLES
2 Pear Tree Court Farringdon Road
London EC1R 0DS(GB)

(54) Computer system which can operate in a plurality of display modes.

(57) A computer system is designed such that display controllers of a plurality of types can be connected thereto. The computer system includes a built-in display controller; an optional display controller; a switch for enabling selection of either the built-in display controller or the optional display controller; a RAM for storing setup data of the system and a system BIOS for actuating the computer system with a display controller to be selected by the user. The built-in display controller includes a ROM in which an ID is written. The system BIOS discriminates the type of the display controller which has been selected by the user, by detecting whether or not the ID can be read.

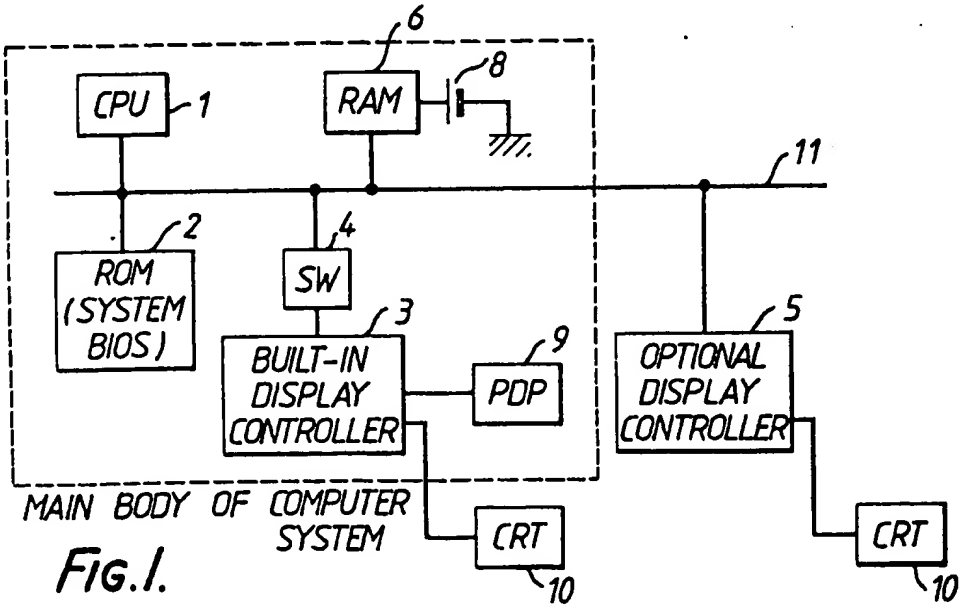

FIG. 1.

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"Computer System which can Operate in a Plurality of Display Modes"

The present invention relate to a computer system to which display controllers of a plurality of types, such as those which may use a CGA (colour graphics adapter) mode, an EGA (enhanced graphics adapter) mode, and a VGA (video graphics array) mode, are connectable.

In recent years there have been developed an increased umber of computer systems which initially incorporate, or permit optional connection of, several types of display controllers (e.g., a CGA,, an EGA, and a VGA), so as to achieve a display function of desired performance.

Display controllers using CGA, EGA, and VGA have the characteristics identified in Table 1 below.

TABLE 1

Mode	Resolution	Color Specification
CGA	640*200 dots	4 colors
EGA	640*350 dots	16 colors can be displayed simultaneously out of 64 colors
VGA	640*480 dots	256 colors can be displayed simultaneously out of 260.000 colors

The display controllers have operated by use of both chips achieving the above specifications and also basic input/output system (BIOS) programs supporting them.

In such a conventional computer system, the display controller which the user wants to use is selected from among available display controllers by operating a switch. Alternatively, it is designated through an input device (e.g.,a keyboard) by executing a setup program or the like after the system is turned on. If the display controller to be used is of a different type from that of the display controlled used last, the user has to determine all the display setup conditions or designate a setup program to be executed.

Some of the conventional computer systems permit an optional display controller to be connected thereto, in addition to a built-up display controller, in such a manner that the optional display adapter is located either inside or outside of the main body of the computer systems. Even if the optional display controller is connected, however, it is usual that the built-up display controller is automatically selected prior to the optional display controller. Therefore, the user is not allowed to freely select the display controller which he or she wants to use.

The present invention has been developed in consideration of the above circumstances, and is intended to provide a computer system which permits the user to freely select either a built-in display controller or an optionally provided display controller, automatically performs a setup operation in accordance with the operating condition of the system, and is actuated with a display controller desired by the user.

In order to solve the problems mentioned above, the computer system of the present invention comprises:

a built-in display controller including a ROM for storing a BIOS including an identification (ID) of the type of display controller which is built-in;

an optional display controller adapted to be connected to the computer system;

a memory for storing setup information regarding the system; and

a ROM for storing a system BIOS, which includes means for: 1) reading the ID of the built-in display controller when the system is turned on, and actuating system, with the built-in display controller selected in accordance with operating conditions of the system and the user selection, and 2) discriminating the type of the optional display controller, executing a setup program in accordance with the discriminated type, and actuating the system, with the display controller selected in accordance with the user selection.

The built-in display controller, the optional display controller, the memory, and the ROM (system BIOS) are connected to a CPU through a system bus.

Figure 1 is a block circuit diagram illustrating the construction of a computer system according to one embodiment of the present invention;

Figure 2 is a block circuit diagram illustrating an example of the construction of the built-in display controller shown in Figure 1;

Figure 3 is an explanatory view showing the structure of the EGA BIOS program relating to Figure 2; and

Figure 4 is a flow chart illustrating the operation of the present invention.

A computer system according to the present invention will now be described in detail, with reference to the accompanying drawings.

FIGURE 1 illustrates the construction of a computer system according to one embodiment of the present invention. Referring to FIGURE I, CPU 1, ROM 2, manual switch 4, RAM 6, and optional display controller 5 are connected to system bus 11. Built-in display controller 3, having a conventional, well-known, structure, is connected to system bus 11 through manual switch 4. Plasma display 9, which is initially provided with the main body of the computer system, is connected to built-in display controller 3. CRT 10, which may be used as an external display, is connectable to optional display controller 5.

CPU 1 constitutes the essential part of the controller of the system. ROM 2 stores a system BIOS program with which to control inputs and outputs of the system. "BIOS" is an abbreviation of "Basic Input Output System" and indicates input/ output control programs for enabling operation of input and output devices connected to a system. Most of the input/output control programs (including a CGA BIOS) are stored in ROM 2 as a part of system BIOS. The input/output programs of built-in display controller 3, when expanded to function in an EGA mode, a VGA mode, etc., are stored in ROM 31 (See FIGURE 2) of display controller 3 as an optional BIOS. Switch 4 is a manual switch to be operated by the user. When this switch is on, the ID in the EGA BIOS stored in ROM 31 of built-in display adapter 3 can be read. When the switch is off, the ID cannot be read.

The specific construction of built-in display adapter 3 is illustrated in FIGURE 2. ROM 31 which stores an EGA BIOS, video RAM 32 which stores display data, EGA chip 33 which generates display signals suitable to plasma display (PDP) 9 and CRT 10, and EGA gate array 34 which controls the display functions of plasma display 9 and CRT 10 are connected to bus 35 of built-in display controller 3. Based on the EGA BIOS program, data is displayed on either PDP 9 or CRT 10 under the control of CPU 1. As is shown in FIGURE 3, the EGA BIOS includes: ID data 311 provided only for an EGA display controller; control program 312 for the EGA; FONT data 313 for the EGA; and FONT data 314 for a CGA. Display controller "EGA" covers the "CGA" function as well. The CGA is controlled on the basis of system BIOS stored in ROM 2.

Built-in display controller 3 described with respect to FIGURES 2 and 3 is capable of the EGA mode, but is not limited thereto. For example, controller 3 can be made to operate in a VGA mode by incorporating a VGA chip, VGA gate array and a VGA BIOS.

Optional display controller 5 may be located either inside or outside of the main body of the system. The internal structure of optional display controller 5 is similar to that of built-in display controller 3. The user can freely determine the type of display controller from among the CGA mode, EGA mode, VGA mode, etc. CRT 10 is connected to optional display 5.

The setup information for the system is written in RAM 6. Battery 8 for backup use is connected to RAM 6.

The operation of the system will now be described, with reference to FIGURE 4.

Either built-in display controller 3 (hereafter "DC") or optional DC 5 is selected beforehand by the user by means of switch 4. In response to this selection, the computer system determines whether or not the ID in built-in DC 3 is readable. When the system is turned on, CPU 1 receives a system actuation command and executes the following operation, on the basis of the system BIOS.

First, the ID written in the BIOS of built-in DC 3 is read at step 402, so as to determine which DC, built-in DC 3 or optional DC 5, has been selected by the user. This ID is included in the EGA BIOS only. If the ID can be read, built-in DC 3 is regarded as having been selected. Accordingly, the system is actuated with built-in DC 3 at step 404.

If the ID cannot be read, optional DC 5 is regarded as having been selected. In this case, built-in DC 3 is temporarily actuated at step 406, using the CGA mode. Since, therefore, the display device of the computer system can be used, an error message or the like can be displayed. The CGA mode is actuated by use of the system BIOS.

Next, it is checked whether or not optional DC 5 is a CGA mode at step 408. If it is found at step 410 that the optional DC 5 is a CGA mode, the system is actuated at step 412 with optional DC 5.

If it is found that optional DC 5 is not a CGA, information representing the type of optional DC 5 is read, on the basis of the memory capacity of the video RAM of optional DC 5. That is, the address space in which a video RAM in optional DC 5 is located is determined. For example, if the address space extends from $B8000_H$ to $BFFFF_H$ (16K bytes), this is appropriate for CGA and if the address space extends from $A0000_H$ to $BFFFF_H$ (32K bytes), this is appropriate for EGA. Since, in this way, the capacity of the video RAM differs upon the type of display controller, it can be used for discriminating the type of the display

controller. The information thus read is compared with the setup information stored in system RAM 6 at step 414. If coincidence is detected in this comparison, the DC to be used is considered to be of the same type as the DC used last. In this case, the display of the system is actuated, using the same optional DC used last at step 416. If coincidence is not detected in the comparison at step 414, the DC to be used is considered to have been replaced with another or removed from the system. Since, in this case, a setup operation must be performed, execution of the setup program is commanded at step 418. There, the user selects at step 420 the type of the DC from among the EGA mode, VGA mode, etc., using the information indicated on the screen. In response to the section, information regarding the DC newly selected by the user is written in RAM 6 at step 422, and the display of the system is actuated at step 424, with the newly selected DC.

Although only a single preferred embodiment of this invention has been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the preferred embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included in this invention as defined by the following claims.

Claims

1. A built-in display controller including a ROM for storing a BIOS including an identification (ID) of the type of display controller which is built-in;
an optional display controller adapted to be connected to the computer system;
a memory for storing setup information regarding the system; and
a ROM for storing a system BIOS, which includes means for: 1) reading the ID of the built-in display controller when the system is turned on, and actuating system, with the built-in display controller selected in accordance with operating conditions of the system and the user selection, and 2) discriminating the type of the optional display controller, executing a setup program in accordance with the discriminated type, and actuating the system, with the display controller selected in accordance with the user selection.

2. A computer system including a CPU (1), a built-in display control means (3) and system control means (2), and having means for connecting at least one optional display control means (5) characterised in that
the computer means further comprises memory means (6) for storing setup information regarding the computer system and input means including switch means (4) for enabling selection of either the built-in display control means (3) or the optional control means (5), the built-in display control means (3) including a ROM (31) including an ID for identifying a display controller of a predetermined type and the system control means (2) including memory means for storing a system BIOS, which includes: means for reading the ID of the built-in display control means (3); means for actuating the computer system, with the built-in display control means (3) selected, if the ID is readable; means for actuating the built-in display control means (3) by use of CGA mode if the ID is not readable, and for discriminating the type of the optional display control means (5); means for comparing the setup information with information representing the type of the optional display control means (5); means for actuating the computer system, with the optional display control means (5) selected, if coincidence is detected in the comparison; and means for executing a setup program if no coincidence occurs, and for actuating the system, with a type of display control means designated by the user.

3. A computer system characterised by;
a built-in display controller (3) having a ROM (31) storing ID information identifying the type of controller;
an optional display controller (5) adapted to be connected to the computer system and having a video RAM; and
processing means (1) for executing a BIOS (2) with which inputs and outputs are controlled on the basis of specification of thee system and in accordance with environmental information of operation set by a user, including:
means for reading the ID information stored in the ROM of the built-in display controller (3) when the system is started, and for actuating the system with the built-in display controller when selected,
means for checking the video RAM in the optional display controller (5) to thereby discriminate the type of the optional display controller (5) to thereby discriminate the type of the optional display controller (5) if the ID cannot be read, and
means for: 1. comparing information representing the type of the optional display controller (5) with the environmental information set by the user, 2) actuating the system with the optional display controller (5) if

coincidence is detected in the comparison, and 3) permitting environmental information to be newly set if no coincidence is detected in the comparison, and actuating the system in accordance with the newly set environmental information.

4. A computer system according to any of claims 1 3, characterised in that the optional display controller (5) is located inside the computer system.

5. A computer system according to any of claims 1 3, characterised in that the optional display controller (5) is located outside of the computer system.

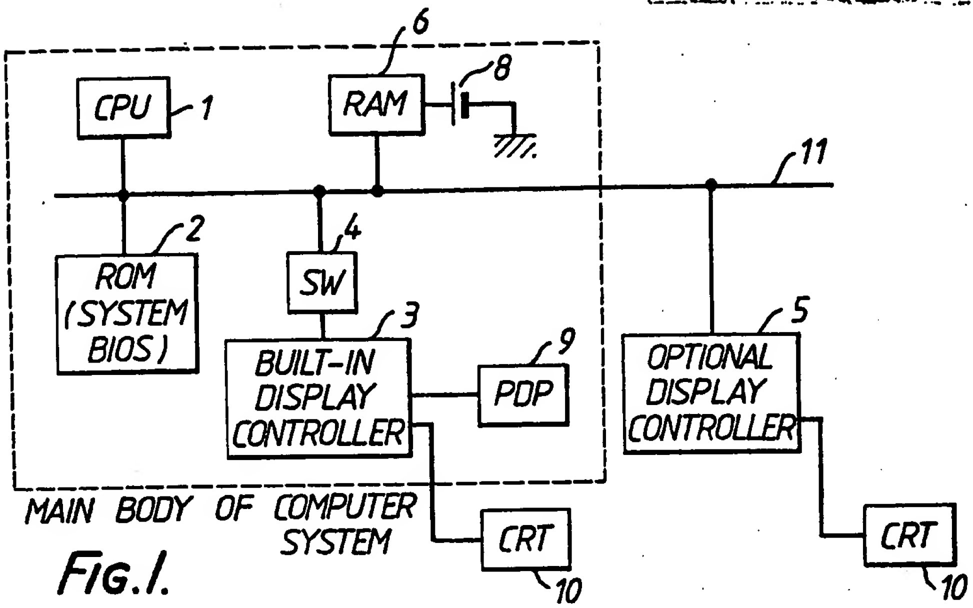

FIG.1.

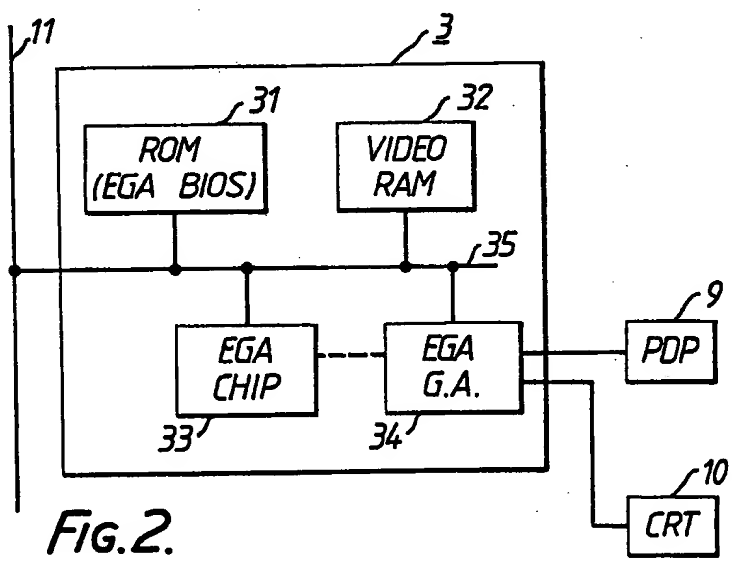

FIG.2.

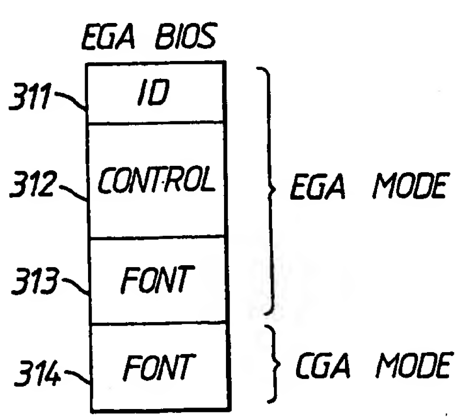

FIG.3.

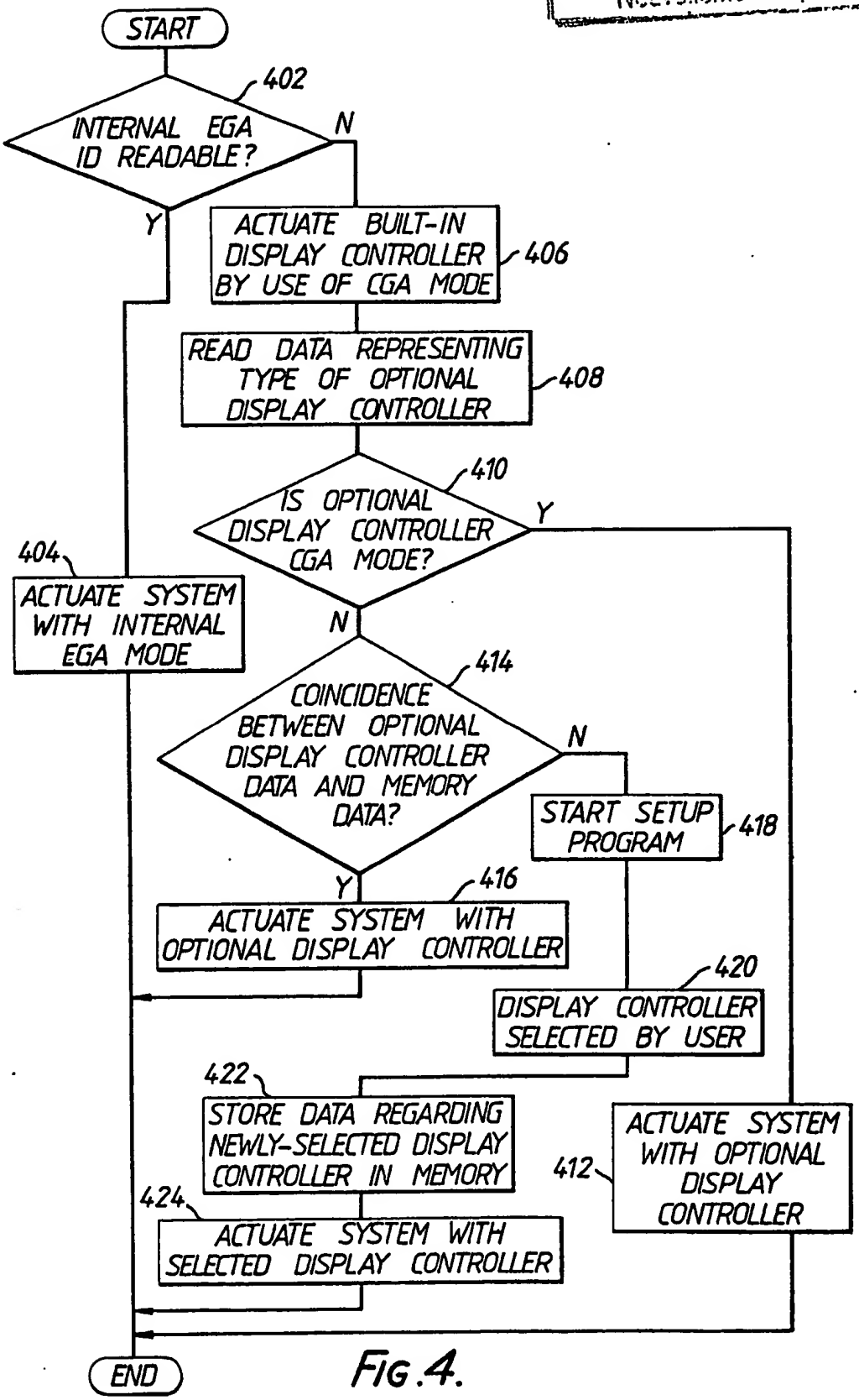

FIG.4.

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(71) Applicant: **KABUSHIKI KAISHA TOSHIBA**
72, Horikawa-cho Saiwai-ku
Kawasaki-shi Kanagawa-ken Tokyo(JP)

(72) Inventor: **Yamaki, Kazunori**
C/o Patent Division Toshiba Corporation
1-1 Shibaura Minato-ku Tokyo(JP)

(74) Representative: **BATCHELLOR, KIRK & CO.**
2 Pear Tree Court Farringdon Road
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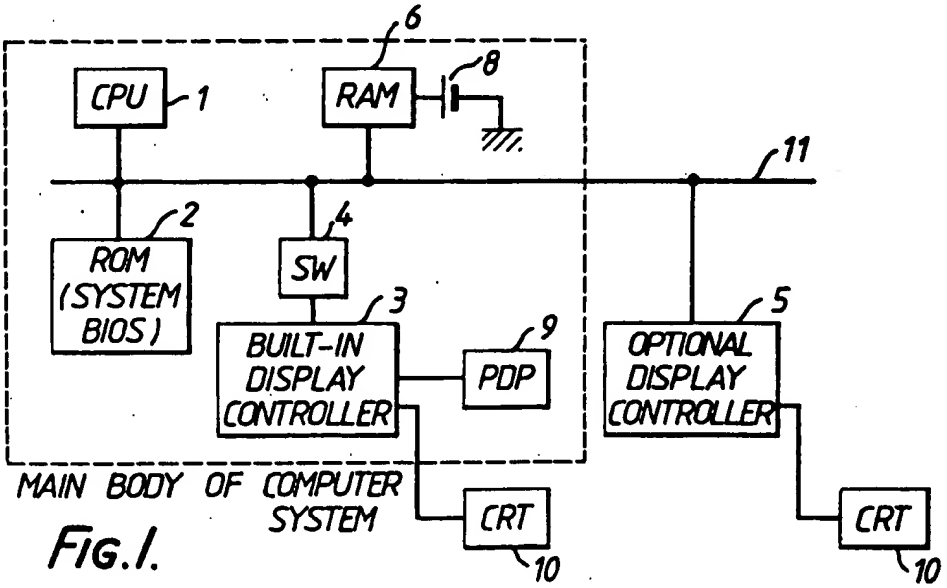

FIG. 1.

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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 0429

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	ELECTRONIC DESIGN vol. 32, no. 20, 1 October 1984, MINNESOTA, U.S.A. pages 259 - 265; GEORGE REIS, DON ZURSTADT: 'MULTIPLE DISPLAY SCHEMES MAKE THEIR MARK ON SMART GRAPHICS STATIONS' * page 263, left column, paragraph 3 - page 265, left column, paragraph 1; figures 3,5 *	1-4	G06F3/153
A	PATENT ABSTRACTS OF JAPAN vol. 11, no. 267 (P-613)8 September 1987 & JP-A-62 075 834 (TOSHIBA CORP.) 7 April 1987 * abstract *	2	
P,A	EP-A-0 295 691 (TOSHIBA K.K.) 21 December 1988 * column 1, line 1 - column 2, line 2; figures 1,7-9 * * column 2, line 37 - column 3, line 24 * * column 4, line 1 - column 6, line 27 *	1-3	
P,A	IBM SYSTEMS JOURNAL vol. 27, no. 2, 1988, ARMONK, N.Y., U.S.A. pages 185 - 197; S. THOMPSON: 'VGA - DESIGN CHOICES FOR A NEW VIDEO SUBSYSTEM' * page 186, right column, paragraph 3 - page 187, left column, paragraph 1 * * page 194, right column, last paragraph *	1-4	TECHNICAL FIELDS SEARCHED (Int. Cl.4) G06F G09G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 DECEMBER 1991	ZENDER J.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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